Student Name: ______________________ ________ J#: ____________________

Jackson State University
CSC 323 Algorithm Design and Analysis, Fall 2018
Instructor: Dr. Natarajan Meghanathan
Exam 2 (Take Home Exam)

Maximum Points: 100 **Due on: Nov. 6th, 11.30 AM**

Print this exam and answer in the space provided. Use additional sheets, if necessary.

You should staple your exam.

Exam 2 should be submitted exactly at 11.30 AM. Any late submission will not be accepted.

Q1 - 20 points) Construct a Huffman code for the following data (show all the steps):

Student Name	Frequency of Symbols					Test Symbol Sequence
	A	B	C	D	E	
Clark, Lavaskie	0.21	0.35	0.16	0.08	0.20	BEAAEDDEBB
Epps, Justin	0.34	0.12	0.07	0.37	0.10	AADADDECCD
Harris, James	0.40	0.20	0.21	0.09	0.10	ACAAECEAEB
Hester, Larriel	0.25	0.20	0.28	0.15	0.12	BADBCDECBD
Hopson, Shanice	0.15	0.24	0.14	0.27	0.20	AEBBADCBEE
Jackson, Martice	0.50	0.2	0.1	0.05	0.15	ACBDAABDAC
Jones, Demarius	0.45	0.18	0.19	0.07	0.11	BEBAAABCBA
Kang, Ning	0.29	0.07	0.10	0.20	0.34	EEAEAEDEEE
Kirk, Damon	0.20	0.30	0.15	0.25	0.10	ABBCBAACBD
Manuel, Jackie	0.35	0.30	0.12	0.20	0.03	AADADBCABB
McIntosh, Blair	0.10	0.16	0.54	0.12	0.08	BCCADCCCCC
Sheffey, Varlin	0.44	0.22	0.11	0.04	0.19	AAABBEABEA
Simmons, Jetnya	0.28	0.27	0.15	0.14	0.16	ACEDDCBACA
Thomas, Eriana	0.10	0.29	0.21	0.32	0.08	BBDBBADDDC
Walker, Brandon	0.25	0.36	0.12	0.18	0.09	BBAEBACBBA
Wynn, Marcus	0.21	0.14	0.15	0.40	0.10	DDACEBADDA
Zimmerman, Taba	0.50	0.05	0.02	0.16	0.27	AAABAEECDA

(a) Determine the average number of bits per symbol.

(b) Determine the generic compression ratio compared to fixed-length encoding.

(c) Encode the given text symbol sequence using the Huffman code that you determined. Compute the compression ratio achieved for this text compared to fixed-length encoding.

Student Name: ______________________ ________ J#: ___________________

Q2 - 23 pts) Given the following items, their weights and values, compute the maximum value of the items that could be accumulated in a knapsack of weight W = 6 lb (also listed in the table). Compute your solutions as:

(i) Fractional Knapsack problem
(ii) Integer Knapsack problem (W = 6 lb)
(iii) Using the result of (ii), determine the total maximum value and the corresponding items that can be picked if the Knapsack weight is reduced to 5 lb.

Show all the work (including the value and history tables for the Integer Knapsack problem)

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Clark, Lavaskie

Item	Value($)	Weight (lb)
1	12	2
2	25	3
3	30	4
4	18	3
5	10	1

Epps, Justin

Item	Value ($)	Weight (lb)
1	20	2
2	13	1
3	25	2
4	39	4
5	27	3

Harris, James

Item	Value ($)	Weight (lb)
1	45	3
2	62	4
3	18	1
4	35	2
5	20	1

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Hester, Larriel

Item	Value($)	Weight (lb)
1	11	1
2	31	4
3	10	2
4	18	3
5	12	2

Hopson, Shanice

Item	Value ($)	Weight (lb)
1	41	3
2	28	2
3	46	4
4	24	2
5	13	1

Jackson, Martice

Item	Value ($)	Weight (lb)
1	19	1
2	80	4
3	25	2
4	45	3
5	15	1

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Jones, Demarius

Item	Value($)	Weight (lb)
1	15	2
2	19	3
3	28	4
4	20	3
5	8	1

Kang, Ning

Item	Value ($)	Weight (lb)
1	10	2
2	12	3
3	19	4
4	8	1
5	14	2

Kirk, Damon

Item	Value ($)	Weight (lb)
1	24	3
2	35	4
3	19	2
4	13	1
5	11	1

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Manuel, Jackie

Item	Value($)	Weight (lb)
1	10	1
2	19	2
3	25	2
4	40	4
5	32	3

McIntosh, Blair

Item	Value ($)	Weight (lb)
1	100	2
2	120	4
3	90	3
4	110	3
5	115	2

Sheffey, Varlin

Item	Value ($)	Weight (lb)
1	14	2
2	20	3
3	15	2
4	10	1
5	30	4

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Simmons, Jetnya

Item	Value($)	Weight (lb)
1	23	2
2	33	3
3	40	4
4	21	2
5	11	1

Thomas, Eriana

Item	Value ($)	Weight (lb)
1	17	2
2	24	3
3	33	4
4	11	1
5	30	3

Walker, Brandon

Item	Value ($)	Weight (lb)
1	15	3
2	20	4
3	22	3
4	12	1
5	17	2

Student Name: _______________________ ________ J#: ____________________

Wynn, Marcus

Item	Value($)	Weight (lb)
1	32	4
2	23	3
3	30	4
4	11	2
5	7	1

Zimmerman, Taba

Item	Value ($)	Weight (lb)
1	7	2
2	14	3
3	23	4
4	11	1
5	20	3

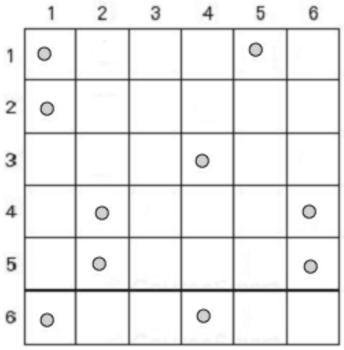
Q3 - 7 points) Using Dynamic Programming, compute the binomial coefficient for the numbers assigned below. Show the table and all the work.

Student # / Name	**n**	**k**
Clark, Lavaskie	13	8
Epps, Justin	10	7
Harris, James	12	9
Hester, Larriel	10	6
Hopson, Shanice	13	5
Jackson, Martice	13	10
Jones, Demarius	12	7
Kang, Ning	11	7
Kirk, Damon	13	11
Manuel, Jackie	10	4
McIntosh, Blair	11	9
Sheffey, Varlin	12	8
Simmons, Jetnya	11	5
Thomas, Eriana	10	8
Walker, Brandon	15	7
Wynn, Marcus	14	8
Zimmerman, Taba	13	9

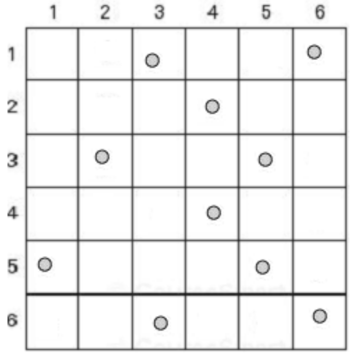
Student Name: ________________________ ________ J#: ____________________

Q4 - 13 points) Several coins are placed in cells of a 6 x 6 board (*n* x *m* board) shown below for each student, with no more than one coin per cell. Assume the value of each coin is 1. Determine a path from cell (1, 1) to cell (6, 6) such that the path traced collects the maximum number of coins (also same as the maximum value of the coins).

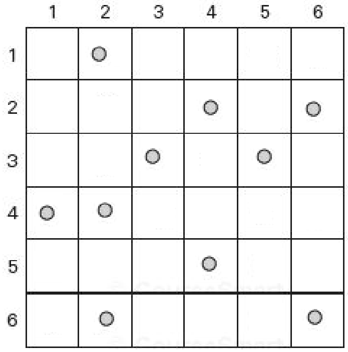
Clark, Lavaskie



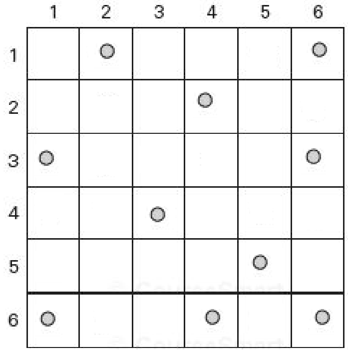
Epps, Justin



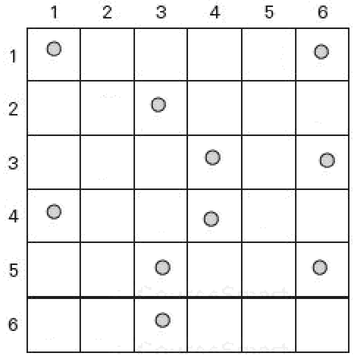
Harris, James



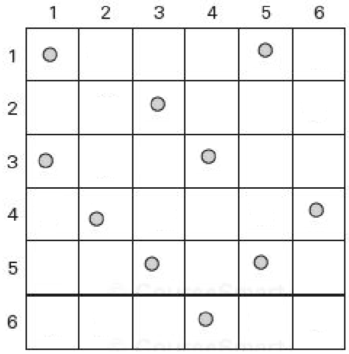
Hester, Larriel



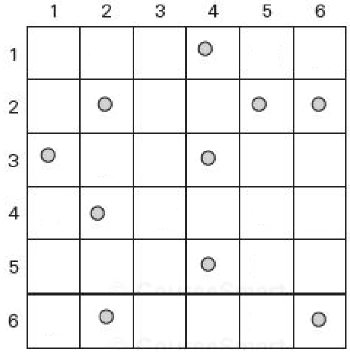
Hopson, Shanice



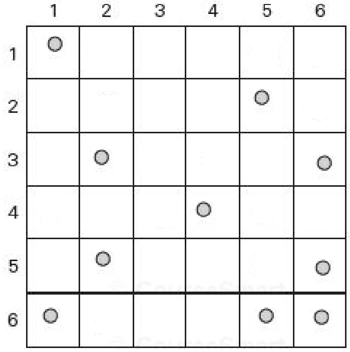
Jackson, Martice



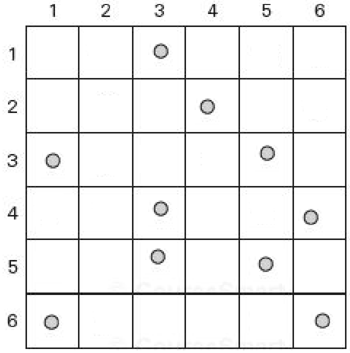
Jones, Demarius



Kang, Ning



Kirk, Damon



Student Name: ________________________ ________ J#: ____________________

Manuel, Jackie

	1	2	3	4	5	6
1		○			○	
2		○				○
3			○			
4	○			○		
5					○	○
6			○			

McIntosh, Blair

	1	2	3	4	5	6
1				○		○
2		○			○	
3		○		○		
4	○				○	
5			○		○	
6				○		

Sheffey, Varlin

	1	2	3	4	5	6
1		○			○	
2			○			○
3	○			○		
4			○			○
5					○	
6	○		○			

Simmons, Jetnya

	1	2	3	4	5	6
1	○		○		○	
2	○					○
3		○		○		○
4			○		○	
5		○		○		
6			○			○

Thomas, Eriana

	1	2	3	4	5	6
1			○		○	
2		○			○	
3	○			○		○
4			○		○	
5		○				○
6	○		○			

Walker, Brandon

	1	2	3	4	5	6
1			○			
2		○	○		○	
3				○		○
4	○		○			
5		○		○		
6					○	

Wynn, Marcus

	1	2	3	4	5	6
1			○			○
2		○			○	
3	○		○			
4			○			
5		○				○
6	○			○		

Zimmerman, Taba

	1	2	3	4	5	6
1	○			○		
2		○				○
3		○		○		
4	○		○		○	
5		○		○		○
6			○			○

Student Name: ______________________ ________ J#: ___________________

Q5 - 17 points) Given the sequences below, find the longest common sub sequence using the dynamic programming formulation discussed in class. Show the table and all the work. Also, show the final alignment of the two sequences (along with the gaps).

Student Name	**Row Sequence**	**Column Sequence**
Clark, Lavaskie	TCGCCTT	GGGGTAACT
Epps, Justin	TAAAATCTAG	CTTGGATC
Harris, James	GTGTGGAAAC	GCTTCTTTCT
Hester, Larriel	AGGACGGTGAA	AATTTTTA
Hopson, Shanice	CGGCCAGGCGAT	CGAGGTAAGTAG
Jackson, Martice	GCTATTAT	ATAGAAATC
Jones, Demarius	TTCTGATGTT	TCGGGAT
Kang, Ning	CAGATGTATCTG	GAGACAGGAT
Kirk, Damon	CTCAGGT	GTGAGGGGGA
Manuel, Jackie	GATTGCACTA	GTAGCAGT
McIntosh, Blair	GCTAAGC	AGTGCCG
Sheffey, Varlin	ATCACC	GCTCGATCTGCA
Simmons, Jetnya	TTTTAATCCAGC	TGCAGAGAACTA
Thomas, Eriana	GAGTAAG	GCGACG
Walker, Brandon	CCCCTATAGT	CTGACG
Wynn, Marcus	AGAGGC	CAATCGCAACGC
Zimmerman, Taba	TATCAA	TGGACTCCGCAC

Student Name: ______________________ ________ J#: ___________________

Q6 - 20 pts) Consider the coin denomination array (CD) and the sum of the coin values (S) assigned to you. Use the dynamic programming algorithm discussed in class to determine the minimum number of coins and the actual coin values that one would pick up so that the sum of the coin values is S.

Show the contents of the MNC and LCP arrays for each iteration, as discussed in the slides. Discuss how you would trace the solution to determine the actual coin values that need to be picked up for the given S.

Assume an infinite supply of coins for each value. Break any tie in favor of the coin with a lower index in the CD array.

	Coin Denomination Array (CD)	Sum of the Coin Values (S)
Clark, Lavaskie	1 4 5 6	20
Epps, Justin	2 3 7 6	18
Harris, James	2 5 7 4	22
Hester, Larriel	3 6 1 7	16
Hopson, Shanice	1 5 6 3	22
Jackson, Martice	2 5 6 7	23
Jones, Demarius	5 7 2 4	23
Kang, Ning	2 1 5 6	22
Kirk, Damon	1 4 7 2	19
Manuel, Jackie	7 6 2 3	19
McIntosh, Blair	5 6 7 4	25
Sheffey, Varlin	2 7 3 6	25
Simmons, Jetnya	1 6 2 5	21
Thomas, Eriana	7 6 5 3	25
Walker, Brandon	7 5 1 2	24
Wynn, Marcus	4 1 6 3	20
Zimmerman, Taba	5 2 6 1	21